**Middle School Computers I**

**Week 8: Truth Tables and Logic Problems**

**Creating a Truth Table**

(A)||(A||!B)

1. Set up truth table with variables on left hand side and the equation to be solved on the right :

|  |  |  |
| --- | --- | --- |
| **A** | **B** | **A||(A||!B)** |
|  |  |  |

1. Fill in all possible values for variables:

|  |  |  |
| --- | --- | --- |
| **A** | **B** | **A||(A||!B)** |
| 0 | 0 |  |
| 0 | 1 |  |
| 1 | 0 |  |
| 1 | 1 |  |

1. If the equation is complex, consider breaking it down:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **A** | **B** | **!B** | **A||!B** | **A||(A||!B)** |
| 0 | 0 |  |  |  |
| 0 | 1 |  |  |  |
| 1 | 0 |  |  |  |
| 1 | 1 |  |  |  |

1. Fill in values:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **A** | **B** | **!B** | **A||!B** | **A||(A||!B)** |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 |

1. Check your work.

**Sample problems (answers on following pages)**

1. (A&&B)||(!A||B)
2. A||(B||!C)
3. (A&&B)||(B&&C)
4. (A&&B)||(B||!A)||(!B)
5. A||(B&&C)||(C||!A)
6. (A&&B)||(!A||B)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **A** | **B** | **A&&B** | **!A** | **!A||B** | **(A&&B)||(!A||B)** |
| 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 0 | 1 | 1 |

1. A||(B||!C)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **A** | **B** | **C** | **!C** | **B||!C** | **A||(B||!C)** |
| 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 0 | 0 | 1 |
| 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 1 | 0 | 1 | 1 |

1. (A&&B)||(B&&C)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **A** | **B** | **C** | **A&&B** | **B&&C** | **(A&&B)||(B&&C)** |
| 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 |

1. (A&&B)||(B||!A)||(!B)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **A** | **B** | **A&&B** | **!A** | **B||!A** | **!B** | **(A&&B)||(B||!A)||(!B)** |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 1 | 0 | 1 |

1. A||(B&&C)||(C||!A)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **A** | **B** | **C** | **B&&C** | **A!** | **C||A!** | **A||(B&&C)||(C||!A)** |
| 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 | 1 | 1 |

**Hints:**

* In the case of an OR operation, only a single true in the whole equation means the whole equation will be true. **In OR, look for 1s!** For example:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **A** | **B** | **C** | **B&&C** | **A!** | **C||!A** | **A||(B&&C)||(C||!A)** |
| 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 | 1 | 1 |

Our final equation is all ORs, so just looking at the last column we can fill in most of the truth table.

* In the case of an AND operation, only a single false will make the whole equation false. **In AND, look for 0s!** For example:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **A** | **B** | **C** | **B&&C** | **A!** | **C||!A** | **A&&(B&&C)&&(C||!A)** |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| 0 | 0 | 1 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 0 | 1 | 1 |

Our final equation is all ANDs, so if we look for the places where there are many zeroes, we can easily compute the truth table.